WHAT IS CLAIMED IS:

1. An optical device comprising:

a protective filter interposed at each of both ends of a barrel with plural optical elements disposed therein;

wherein the plural optical elements are located between the protective filters; and;

wherein an inert gas is filled in advance in a chamber between the plural optical elements and a space between the optical elements on both end sides thereof and the protective filter.

2. The optical device as claimed in claim 1, wherein:

the optical device is installed in an apparatus to irradiate a mask with an illuminating light and to expose a substrate to the illuminating light through the mask; and

the inert gas is an inert gas having a low degree of capability of absorbing the illuminating light.

3. The optical device as claimed in claim 2, wherein the illuminating light has a wavelength of 350 nm or less.

4. The optical device as claimed in claim 2, wherein:

upon mounting the optical device on a light passage housing of an illumination optical system disposed in the exposure apparatus, the protective filter is detached while purging the space with the gas; and

the light passage housing is then filled with the gas.

5. The optical device as claimed in claim 2, wherein:

upon mounting the optical device on a light passage housing of an illumination optical system of the exposure apparatus, the protective filter is detached while purging

the space with the gas;

another protective filter pre-cleaned is mounted at both ends in the axial direction of the barrel; and

the light passage housing is then filled with the gas.

6. The optical device as claimed in claim 2, wherein:

the exposure apparatus is further provided with a stage system to transfer the mask relatively to the illuminating light and to transfer the substrate relatively to a projection optical system of the exposure apparatus.

7. The optical device as claimed in claim 2, further comprising:

an illuminating light source for the illuminating light disposed separately from the projection exposure apparatus; and

a light sending system having at least one optical element to lead the illuminating light leaving from the illuminating light source to an illumination optical system disposed in the projection exposure apparatus and to adjust a position relationship between an optical axis of the illumination optical system and the illuminating light;

wherein the light sending system is disposed in a barrel which is filled with a gas having a lower capability of absorbing the illuminating light.

8. An optical device, comprising:

a supply passage which supplies an inert gas into a barrel with plural optical elements disposed therein;

a supply inlet connected to the supply passage;

an exhaust outlet which discharges the inert gas in

the barrel; and

a removing member which removes a contaminating material, and which is disposed on an inner wall of the supply passage.

9. The optical device as claimed in claim 8, wherein:

the optical device is installed in an apparatus for irradiating a mask with an illuminating light and exposing a substrate to the illuminating light through the mask; and

the inert gas is a gas having a lower capability of absorbing the illuminating light.

10. The optical device as claimed in claim 9, wherein:

the illuminating light has a wavelength of 350 nm or less.

11. The optical device as claimed in claim 9 or 10, wherein:

the exposure apparatus further comprises an illumination optical system for irradiating the mask with the illuminating light and a projection optical system for projecting the illuminating light leaving from the mask onto the substrate; and

the optical device is installed at least at a portion of the illumination optical system and the projection optical system.

12. The optical device as claimed in claim 11, wherein:

the exposure apparatus is further provided with a stage system to transfer the mask relatively to the illuminating light and to transfer the substrate relatively to a projection optical system of the exposure apparatus,

in synchronization with the transfer of the mask.

13. The optical device as claimed in claim 11, wherein:

the exposure apparatus further comprises a light sending system interposed between a light source which emits the illuminating light and the illumination optical system; and

the light sending system is disposed in a housing which is filled with a gas having a lower capability of absorbing the illuminating light.

14. The optical device as claimed in claim 13, wherein:

the light source is disposed separately from the exposure apparatus; and

the light sending system has an optical element in order to adjust a position relationship between an optical axis of the illumination optical system and the illuminating light leaving from the light source.

15. The optical device as claimed in any one of claims 8 to 10, further comprising:

a movable member disposed in the supply passage;

wherein the removing member comprises an adsorbing member or a filter.

16. An optical device installed in an exposure apparatus to transfer a pattern on a mask onto a substrate, wherein:

the optical device is provided with a removing member to remove a contaminating material on an inner surface of a barrel with plural optical elements disposed therein; and

the optical device is disposed between a light source of an illuminating beam and the substrate.

17. The optical device as claimed in claim 16, wherein:

the exposure apparatus comprises a projection optical system to project an image of the pattern onto the substrate.

18. An optical device for use with an exposure apparatus to irradiate a mask with an illuminating light and to transfer a pattern on the mask onto a substrate, wherein:

the optical device has plural chambers formed between plural optical elements disposed in a barrel, each chamber being provided with a gas supply inlet and a gas discharge outlet for a gas having a lower capability of absorbing the illuminating light; and the gas supply inlet and the gas discharge outlet being each provided with an opening-closing valve.

19. The optical device as claimed in claim 18, wherein:

the exposure apparatus has a projection optical system interposed between the mask and the substrate in order to form an image of the pattern on the substrate.

20. The optical device as claimed in claim 18, wherein:

the plural chambers formed between plural optical elements disposed in the barrel are divided into at least two groups, each group having a predetermined number of chambers; each group being provided with a gas supply inlet and a gas discharge outlet; and the gas supply inlet and the gas discharge outlet being each provided with an opening-closing valve.

21. A method for cleaning an optical device for use with an exposure apparatus for irradiating a mask with an

illuminating light and transferring a pattern on the mask onto a substrate, wherein the optical device has plural chambers formed between plural optical elements disposed in a barrel, each chamber being provided with a gas supply inlet and a gas discharge outlet for a gas having a lower capability of absorbing the illuminating light; and the gas supply inlet and the gas discharge outlet being each provided with an opening-closing valve; said method is characterized by the steps of:

filling the barrel with the gas to a predetermined level of pressure in a state in which the opening-closing valve for the gas supply inlet is opened while the opening-closing valve for the gas discharge outlet is closed;

allowing a contaminating material attached to a surface of each of the optical elements to become suspended or afloat by irradiation with the illuminating light in a state in which the opening-closing valves of the gas supply inlet and the gas discharge outlet are closed;

flowing the gas outside and inside the barrel by opening the opening-closing valve of the gas supply inlet and the opening-closing valve of the gas discharge outlet; and

closing the opening-closing valves of the gas supply inlet and the gas discharge outlet.

22. The cleaning method as claimed in claim 21, wherein:

the gas flows in each of the plural chambers, prior to closing the opening-closing valve of the gas discharge outlet, in a state in which the opening-closing valve of

the gas supply inlet and the opening-closing valve of the gas discharge outlet are both opened.

23. The cleaning method as claimed in claim 21, wherein:

the optical device is configured such that the plural chambers are divided into at least two groups, each group having a predetermined number of chambers; each group being provided with a gas supply inlet and a gas discharge outlet; and the gas supply inlet and the gas discharge outlet being each provided with the opening-closing valve.

24. A projection exposure apparatus that forms a pattern on a mask onto a substrate, comprising:

an optical device having plural chambers formed between plural optical elements disposed in a barrel, each chamber being provided with a gas supply inlet and a gas discharge outlet for a gas having a lower capability for absorbing a illuminating light, and the gas supply inlet and the gas discharge outlet being each provided with an opening-closing valve; wherein:

the optical device is cleaned by a cleaning method characterized by the steps of:

filling the barrel with the gas to a predetermined level of pressure in a state in which the opening-closing valve for the gas supply inlet is opened while the opening-closing valve for the gas discharge outlet is closed;

allowing a contaminating material attached to a surface of each of the optical elements to become suspended or afloat by irradiation with the illuminating light in a state in which the opening-closing valves of the gas supply

inlet and the gas discharge outlet are closed;

flowing the gas outside and inside the barrel by opening the opening-closing valve of the gas supply inlet and the opening-closing valve of the gas discharge outlet; and

closing the opening-closing valves of the gas supply inlet and the gas discharge outlet.

25. The projection exposure apparatus as claimed in claim 24, wherein:

the optical device is used as the projection optical system disposed on a path of the illuminating light in order to transfer the pattern on a mask onto the substrate and/or an illumination optical system disposed on a path of the illuminating light in order to irradiate the mask with the illuminating light.

26. The projection exposure apparatus as claimed in claim 24, further comprising:

a stage system connected to the mask and the substrate to transfer the mask relatively to the illuminating light and to transfer the substrate relatively to the illuminating light leaving from the projection optical system, in synchronization with the transfer of the mask.

27. The projection exposure apparatus as claimed in claim 24, further comprising:

a light source system disposed between the light source and an illumination optical system which irradiates the mask with the illuminating light, the light source

system being disposed in a housing having a lower capability of absorbing the illuminating light.

28. The projection exposure apparatus as claimed in claim 27, wherein:

the light source is disposed separately from the projection optical system; and

the light source system has an optical element in order to adjust a position relationship between an optical axis of the illumination optical system and the illuminating light leaving from the light source.

29. The projection exposure apparatus as claimed in claim 24, wherein:

the optical device is configured such that the plural chambers are divided into at least two groups, each group having a predetermined number of chambers and being provided with a gas supply inlet and a gas discharge outlet for the gas, and the gas supply inlet and the gas discharge outlet being each provided with an opening-closing valve.

30. An exposure apparatus which transfers a pattern of a mask onto a substrate, comprising:

an optical system interposed between a light source and the substrate; and

an optical unit having a protective filter disposed at least at an end of a barrel holding an optical element and having the barrel filled with a gas having a lower capability of absorbing the illuminating beam, the optical unit being disposed in the optical system.

31. The exposure apparatus as claimed in claim 30,

wherein:

the optical system includes an illumination optical system disposed on a path of illuminating beam in order to irradiate the mask with the illuminating light; and

the optical unit is disposed in the illumination optical system.

32. The exposure apparatus as claimed in claim 30, wherein the protective filter is detached from the barrel or replaced with another protective filter upon mounting the optical unit on the optical system.

33. The exposure apparatus as claimed in claim 30, further comprising:

a gas supply device connected to the optical system to supply a gas having a lower capability of absorbing the illuminating light to the optical system;

wherein the gas supply device is operated after the illuminating beam has been irradiated in a state in which the optical system is filled with the gas.

34. The exposure apparatus as claimed in claim 33, further comprising:

an exhaust device connected to the optical system to exhaust a gas in the optical system;

wherein the exhaust device is operated before the optical system is filled or supplied with the gas.

35. An exposure apparatus which transfers a pattern of a mask onto a substrate, comprising:

an optical system interposed between a light source of an illuminating beam and the substrate;

a gas supply device which supplies a gas having a lower capability of absorbing the illuminating beam to at least a portion of the optical system; and

an exhaust device which exhausts the gas from the at least the portion of the optical system prior to a supply of the gas.

36. The exposure apparatus as claimed in claim 35, wherein:

the optical system comprises an illumination optical system which irradiates the mask with the illuminating beam, a light sending system interposed between the light source and the illumination optical system, and a projection optical system which projects the illuminating beam leaving from the mask onto the substrate.

37. The exposure apparatus as claimed in claim 35, wherein:

the exhaust device and the gas supply device are operated one after another after subjecting the optical system to light cleaning by irradiation with the illuminating beam.

38. The exposure apparatus as claimed in claim 30 or 35, wherein the illuminating beam has a wavelength ranging from 100 to 200 nm.

39. The exposure apparatus as claimed in claim 38, wherein:

the illuminating beam is ArF excimer laser or F_2 laser; and

the gas is nitrogen or helium.

40. A method for manufacturing an apparatus which exposes a substrate to an illuminating beam through a mask, comprising:

filling a barrel with an optical element disposed therein with a gas having a lower capability of absorbing the illuminating beam, the barrel being provided with a protective filter at least at an end thereof; and

interposing the barrel between a light source of the illuminating beam and the substrate.

41. The method for manufacturing the exposure apparatus as claimed in claim 40, wherein:

the protective filter is detached or replaced with another protective filter after the barrel has been disposed.

42. A method for manufacturing an apparatus which exposes a substrate to an illuminating beam through a mask, said method is characterized by the steps of:

irradiating at least a portion of an optical system which leads the illuminating beam to the substrate with a cleaning light; and

replacing the gas in the optical system with a gas having a lower capability of absorbing the illuminating beam.

43. The method for manufacturing the exposure apparatus as claimed in claim 42, wherein:

the gas in the optical system is exhausted therefrom before a gas having a lower capability of absorbing the illuminating beam is supplied to the optical system.

44. The method for manufacturing the exposure apparatus as claimed in claim 42, wherein:

the gas having a lower capability of absorbing the illuminating beam is supplied to the optical system before irradiation with the cleaning light.

45. The method for manufacturing the exposure apparatus as claimed in claim 42, wherein:

the cleaning light comprises the illuminating beam; and

the optical system comprises an illumination optical system disposed on a path of the illuminating beam in order to irradiate the mask with the illuminating beam, and a projection optical system disposed on a path of the illuminating beam in order to project the illuminating beam leaving from the mask onto the substrate.

46. An optical device, comprising:

a barrel with plural optical elements disposed therein;

a protective filter disposed apart in a predetermined distance with respect to an optical element out of the plural optical elements, which is disposed at least at one end side in the axial direction of the barrel; and

the protective filter is detachably mounted on the barrel.

47. The optical device as claimed in claim 46, wherein:

the protective filter is detachably mounted each on the both end portions in the axial direction of the barrel.

48. The optical device as claimed in claim 47, wherein:

an inert gas is filled in a chamber interposed between the plural optical elements and in a space interposed between the optical elements disposed on the both end sides and the plural protective filter.

49. The optical device as claimed in claim 48, wherein:

the optical device is installed in an apparatus that forms a pattern on a mask onto a substrate; and

the inert gas is a gas having a lower capability of absorbing the illuminating light.

50. A method of storing an optical device with plural optical elements disposed; wherein:

the optical device has a barrel with plural optical elements disposed therein;

the method of storing is characterized by the steps of:

irradiating a surface of each of the optical elements with a light for removing a contaminating material attached on the surface of each of the optical elements;

filling the barrel with an inert gas to a predetermined level of pressure after the contaminating material removed from the surface of each of the optical elements has been discharged from the barrel; and

storing the optical device in a state in which the barrel is filled with the inert gas.

51. The method of storing as claimed in claim 50, wherein:

the optical device is provided with a gas supply inlet connected to the barrel to supply the inert gas into

the barrel and a gas discharge outlet connected to the barrel to discharge the gas in the barrel, the gas supply inlet and the gas discharge outlet being each provided with an opening-closing valve;

the storing method is characterized by the steps of:

filling the barrel with the inert gas to a predetermined level of pressure by opening the opening-closing valve for the gas supply inlet and closing the opening-closing valve of the gas discharge outlet, prior to irradiating the surface of the optical element with the light;

floating the contaminating material by irradiating the surface of the optical element with the light after closing the opening-closing valve of the gas supply inlet in a state in which the pressure in the barrel has reached its predetermined level of pressure;

flowing the inert gas inside and outside the barrel by opening the opening-closing valves of the gas supply inlet and the gas discharge outlet; and

closing the opening-closing valves of the gas supply inlet and the gas discharge outlet after the inert gas has been allowed to flow inside and outside the barrel.

52. The method of storing as claimed in claim 50, wherein:

the optical device is provided with a gas supply inlet connected to the barrel to supply the inert gas into the barrel and a gas discharge outlet connected to the barrel to discharge the gas in the barrel, the gas supply

inlet and the gas discharge outlet being each provided with an opening-closing valve;

the storing method is characterized by the steps of:

discharging the contaminating material, together with the inert gas, from the barrel through the gas discharge outlet;

filling the barrel with the inert gas to a predetermined level of pressure by opening the opening-closing valve for the gas supply inlet and closing the opening-closing valve of the gas discharge outlet, after discharging the contaminating material; and

closing the opening-closing valve of the gas supply inlet after the inert gas has been filled.

53. The method of storing as claimed in claim 52, wherein the surface of the optical element is irradiated with the light in a state in which the opening-closing valves of the gas supply inlet and the gas discharge outlet are opened.

54. The method of storing as claimed in claim 50, wherein the light has a wavelength of 350 nm or less.

55. The method of storing as claimed in claim 50, wherein:

the optical device has each of plural chambers provided with the gas supply inlet and the gas discharge outlet, each chamber being formed between plural optical elements disposed in the barrel.

56. The method of storing as claimed in claim 50, wherein:

the optical device is installed in an apparatus that

forms a pattern on a mask onto a substrate.

57. The method of storing as claimed in claim 56, wherein the apparatus is an exposure apparatus.

58. The method of storing as claimed in claim 50, wherein the optical device comprises an alignment optical device which detects a position of an alignment mark formed on a mask or a substrate.

59. The method of storing as claimed in claim 50, wherein the optical device comprises an measurement device which measures an optical characteristic of a projection optical device which transfers a pattern of a mask onto a substrate.

60. A method of manufacturing an exposure apparatus which exposes a substrate with an illuminating beam through a mask, wherein:

the exposure apparatus has a light passage housing to cover a light passage of the illuminating beam and an opening-closing valve on the housing side connected to a pipe for supplying an inert gas; and

an optical device to be mounted on the light passage housing comprises a barrel having plural optical elements disposed therein and being filled with an inert gas, a gas supply inlet connected to the barrel to supply the inert gas to the inside of the barrel, and a gas discharge outlet connected to the barrel to discharge the inert gas inside the barrel, the gas supply inlet and the gas discharge outlet being provided each with an opening-closing valve;

said manufacturing method is characterized by the steps of:

installing the optical device in the light passage housing by opening the light passage housing;

connecting the pipe to the gas supply inlet;

opening the opening-closing valve for the gas supply inlet and the opening-closing valve for the gas discharge outlet; and

closing the light passage housing.

61. The method of manufacturing the exposure apparatus as claimed in claim 60, wherein:

the optical device is further provided with a protective filter disposed apart in a predetermined distance with respect to an optical element out of the plural optical elements, which is disposed on an end side in the axial direction of the barrel;

said manufacturing method is characterized by the steps of:

supplying the inert gas to the inside of the barrel by opening the opening-closing valve on the side of the housing side and the opening-closing valve of the gas supply inlet in a state in which the opening-closing valve of the gas discharge outlet is closed, after the gas supply inlet has been connected to the pipe for supplying the inert gas;

detaching the protective filter in a state in which the inert gas has been supplied; and

opening the opening-closing valve of the gas discharge outlet.

62. The method of manufacturing the exposure apparatus as

claimed in claim 61, wherein:

a new protective filter is mounted after the protective filter has been detached, in a state in which the inert gas is supplied; and

the opening-closing valve of the gas discharge outlet is opened after mounting the new protective filter.

63. The method of manufacturing the exposure apparatus as claimed in claim 62, wherein:

the exposure apparatus has a gas discharge outlet on a main body side to discharge a gas in the light passage housing, the gas discharge outlet being provided with an opening-closing valve;

said manufacturing method is characterized by the steps of:

discharging the gas in the light passage housing by opening the opening-closing valve of the gas discharge outlet on the main body side, after the optical device has been disposed in the light passage housing.

64. An optical device comprising:

a gas supply passage which supplies an inert gas into a barrel with plural optical elements disposed therein;

a gas supply inlet connected to the gas supply passage;

an opening-closing valve which controls a flow rate of the inert gas, which is disposed in the gas supply inlet; and

a filter which removes a contaminating material contained in the inert gas, which is disposed in the gas

supply passage between the gas supply inlet and the opening-closing valve.

65. The optical device as claimed in claim 64, wherein:

a removing member which removes the contaminating material is disposed on an inner wall of the barrel.

66. The optical device as claimed in claim 65, wherein:

a removing member which removes a contaminating material is disposed on an inner wall of the barrel.

67. The optical device as claimed in claim 66, wherein:

the optical device is installed in an apparatus for irradiating a mask with an illuminating light and exposing a substrate to the illuminating light through the mask; and

the inert gas comprises a gas having a lower capability of absorbing the illuminating light.

68. An exposure apparatus which transfers a pattern on a mask onto a substrate, comprising:

a barrel with plural optical elements disposed therein;

a gas supply passage which supplies an inert gas into the barrel;

a gas supply inlet connected to the gas supply passage;

an opening-closing valve which controls a flow rate of the inert gas, which is disposed on the gas supply passage; and

a filter which removes a contaminating material contained in the inert gas, which is disposed on the gas supply passage locating between the gas supply inlet and

the opening-closing valve.

69. The exposure apparatus as claimed in claim 68, wherein:

the barrel is provided at least in an illumination optical system disposed on a path of the illuminating light to irradiate the mask with an illuminating light or a projection optical system disposed on a path of the illuminating light to project the illuminating light leaving from the mask onto the substrate.

70. A method for cleaning an optical device for use with an exposure apparatus which transfers a pattern on a mask onto a substrate by irradiating the mask with an illuminating light, wherein:

the optical device has plural chambers, each of which is provided with a gas supply inlet connected to a barrel to supply a gas having a lower capability of absorbing the illuminating light and a gas discharge outlet connected to the barrel to discharge the gas, each chamber being formed between plural optical elements disposed in the barrel therein, the gas supply inlet and the gas discharge outlet being each provided with an opening-closing valve;

the cleaning method is characterized by the steps of:

allowing a contaminating material attached to a surface of each of the optical elements by irradiating the optical elements with the illuminating light; and

flowing the gas outside and inside the barrel by opening the opening-closing valves of the gas supply inlet and the gas discharge outlet.

71. A projection exposure apparatus which irradiates a mask with an illuminating light and which transfers a pattern on the mask onto a substrate through a projection optical system; comprising:

an optical device having plural chambers, each of which is provided with a gas supply inlet connected to a barrel to supply a gas having a lower capability of absorbing the illuminating light and a gas discharge outlet connected to the barrel to discharge the gas, each chamber being formed between plural optical elements disposed in the barrel therein, the gas supply inlet and the gas discharge outlet being each provided with an opening-closing valve;

wherein the optical device is subjected to a cleaning method characterized by the steps of:

allowing a contaminating material attached to a surface of each of the optical elements by irradiating the optical elements with the illuminating light; and

flowing the gas outside and inside the barrel by opening the opening-closing valves of the gas supply inlet and the gas discharge outlet.

72. An exposing method for irradiating a mask with an illuminating light and transferring a pattern on the mask onto a substrate through a projection optical system, said method is characterized by the steps of:

supplying a gas having a lower capability of absorbing the illuminating light to each of plural chambers each being formed between plural optical elements disposed

in a barrel;

floating a contaminating material attached to a surface of each of the plural optical elements by irradiating the plural optical elements with a light for removing the contaminating material in a state in which the gas is supplied;

flowing the gas outside and inside the barrel for each of the plural chambers;

filling the plural chambers with the gas after flowing the gas; and

transferring the pattern onto the substrate in a state in which the plural chambers are filled with the gas.

73. The exposing method as claimed in claim 72, wherein:

the plural chambers are filled with the gas, after flowing the gas; and

the pattern is transferred onto the substrate in a state in which the plural chambers are filled with the gas.

74. The exposing method as claimed in claim 72, wherein:

the pattern is transferred onto the substrate while continuing the supply of the gas to the plural chambers, after flowing the gas.

75. The exposing method as claimed in claim 72, wherein the light for removing the contaminating material comprises the illuminating light.